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Study of Electrical Energy Audit for Energy Consumption

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ABSTRACT: *Energy is very much important input in all sectors of any country's economy. The standard of living of any country can be directly related to per capita energy consumption. The ever increasing population on the world and increased standard of living of human being has no doubt put a tremendous pressure on Earth's Resources. In this research paper, Study of Energy Conservation and Energy Audit in collage hostel and biotechnology lab. It is carried out and very effectively tried to make systematic approach for the same. It is studied that results of energy conservation and energy audit point out possibilities of energy saving, by simple housekeeping measures as well as improved techniques, better instrumentation and more efficient machinery. A careful day to day monitoring of specific energy consumption can help in saving wastage of energy and raw materials.*

Keywords: *Energy Audit; Energy conservation;*

INTRODUCTION

To run equipment use in industrial, commercial, residential and utility application, ac supply is required as input. In the world energy crisis is one of the major problems. In developing countries like India, where electrical energy resources are scarce and production of electricity is very costly, energy conservation studies are of great importance. In order to reduce energy consumptions for sustainable and energy-efficient manufacturing, continuous energy audit and process tracking of industrial machines are essential. Energy Audit involves proper planning, directing and controlling of supply and input – output ratio of consumption of energy to maximize productivity and minimize energy costs (Harishkumar Agarwal 2012). As per the energy Conservation Act. 2001 " Energy Audit" is define as the verification, monitoring and analysis of use of energy including submission of technical report containing, recommendation for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption (Bibhu Prasad Rath and Prof. Javaid Akhter 2012). Systematic approach, to monitor industrial energy consumption and to pin point source of wastage, is known as energy audit.

India's high industrial energy intensity is due to the fact that successive development plan have laid emphasis on developing a self reliant industrial structure with the result a great deal of investment was developing basic & energy intensive, the industrial sector is also insufficient in its use of energy, when compared with international best practice, there is immense scope for energy saving in institute like money, electrical energy is a vital resource & it is getting costlier & scarcer. (Ali. M. A. 2002-2003).

WHY IS IT NECESSARY?

An energy audit study helps an organization to understand and analyses its energy utilization and identify areas where energy use can be reduced, decide on how to budget energy use, plan & practice feasible energy conservation methods that will enhance their energy efficiency, curtail energy wastage & substantially reduce costs.

The energy audit serves to identify all the energy streams in a facility, qualify energy usage with its discrete functions, in an attempt to balance total energy input with its use. Energy audit is thus the key to a systematic approach for decision making in the area of energy management. As a result, the

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energy audit study becomes an effective tool in defining and pursuing comprehensive energy management program (EMP) (Shinde 2002-2003).

In today's power scenario industrial tariff rate is Rs. 4.5/KWH, with increase in electricity tariff. It has become necessary to ensure that electric energy is utilized more efficiently & therefore an electrical audit has become essential.(Shinde 2002-2003).

Prakash Nayak stated that the electricity consumption for illumination rarely exceeds 5% of total consumption. Proper design selection and maintenance can however lead to some savings.The following points must be considered.

- Required lighting levels for different work areas.
- Selection of light sources.
- Maintenance and Effective Control.

The actual value of lighting levels for different work areas is a controversial subject. In India, maximum advantage should be taken of the excellent natural lighting available throughout the year. Maintenance and control of lighting must be done very carefully.

Keeping in view the importance of energy saving we decided to do this research that is the performance of electrical energy Audit evaluated in the ladies hostel, Dr. A.S.C.A.E., M.P.K.V.,Rahuri having 20 rooms, 4 lobbies, a mess, a kitchen, a TV Hall with total 51 tubes of 40 watt fitted & 25 fans, 4 geysers, a TV, a water cooler connected, where performance of major light intensity in each room is evaluated during 2007-08.

As well as performance is evaluated in tissue culture laboratory. Energy audit is the prime step to identify losses. it is a study that evaluate the most appropriate ways to reduce energy cost. Thus, "Electrical management system-the ideal tool ",for energy saving opportunities.

Hence two case studies are carried out for electrical energy audit:

(1) Tissue culture lab. at bio-technology building.

(2) Ladies hostel, Dr.A.S.C.A.E.,M.P.K.V., Rahuri.

The study for conducting electrical energy audit firstly actual energy consumption, requirement of electrical energy was studied. Hence an experimental set-up was examined in laboratory for energy consumption of different available sources. By using the result of this set-up further analysis was done.

This project work is divided in two locational case-studies such as :

1. Ladies hostel, Dr. A.S.C.A.E., M.P.K.V., Rahuri.
2. Biotechnology laboratory, M.P.K.V., Rahuri.

D. R. Wulfinghof (1999), handbook of "Energy Efficiency Manual". Gave information of illumination terminologies. Eg. Lumens, Brightness, Lux etc. On the basis of that information we used the materials for energy consumption are the Luxmeter for measuring light intensity, Ammeter for current,Voltmeter for voltage measurement , Wattmeter for power measurement and Thermometer for measuring temperature of water.

A. Rajkumar (2006), delivers the topic light pollution which gives information about causes of light pollution, findings, prevention.

Energy waste occurs whenever our lighting produces glare, up light, light trespass, & over lighting. It also occurs when we use insufficient light sources. Moreover, burning fossil fuels generates the majority of the electricity used to power streetlights, which in turn compounds the pollution problem. You do not leave your refrigerator door open, the cap off your petrol tank, or the lights on in an empty room. So why should we waste energy lighting the sky when it is the ground we need illuminated? A typical 100W incandescent bulb could consume 341 kg of coal & emit 909 kg of co2 in one year – just one bulb! Such bulbs are also harmful to the night environment. Light pollution affects the behavior of nocturnal animals & birds also. This information is collected by Source: BEE, Oct.2005.

Energy Audit for Ladies Hostel

The performance of electrical energy audit was evaluated at Ladies hostel, Dr. A.S.C.A.E., M.P.K.V., Rahuri, having 20 rooms, 4 lobbies, a mess, a kitchen, a TV Hall with total 51 tubes of 40 watt fitted & 25 fans ,4 geysers, a TV, a water cooler connected, where performance of major light intensity in each room is evaluated as per the layout given. The different locations are selected for noting observations was marked.

1. Light intensity is measured in each room, TV-Hall, Mess, Kitchen, Store-Room & Lobbies at specific location with help of luxmeter & reading is noted down.
2. TV-hall, mess, kitchen, & lobbies at interval of 4hrs. From 8.00 am up to 8.00pm. The readings are taken at 8.00am, 12 noon, 4.00 pm & 8.00pm.

3. Intensity was measured at each 1 hour interval from 8.00 am to 12 midnight in room no. 3, 4 & 12, at specific locations.(Table 1, 2 & 3)

ELECTRICAL ENERGY AUDIT IN TISSUE CULTURE LAB SET-UP

The room for incubating cultures is maintained at a controlled temperature usually air conditioners & heaters are used to maintain the temperature around 25+2 ° celcius.

The culture room is connected to a stand by power generator. The culture room is provided with designated shelving to store cultures. The shelves of 1200 x 1200 mm size with 400 mm height of each compartment may be ideal. Each shelf may have 4 to 6 compartments.

Fluorescent tubes are fixed to the lower surface of compartment to give diffuse light of 1000 to 4000 lux. It should controlled by timers to provide require photoperiod automatically.

Relative humidity of culture room should be above 50% to 70%. Provision to increase humidity if falls below 50% RH should be made. Hygrometer be fixed in the culture room for observing temperature and humidity. The culture room should have a shaking machine to suspension cultures. Dark incubation facility may also be provided.

In-vivo transfer area/ Hardening area

In this area complete plantlets developed by tissue culture are taken out from the flasks/ tubes/ bottles and kept for in-vivo establishment ie Hardening.

For hardening the tissue culture plants a green house/acclimatization area should be provided. It should have areas with relative humidity of above 90%, 80%, to 90%, 50 to 70% etc. With light intensity of above 3000 lux.

For testing performance the set-up of tubes of different wattage in & make 3 parts of one rack was arranged in lab. This is identical set-up with set-up present in tissue culture Lab. There are 3 parts in 1 rack, in 1st part; tube of 28 watt is used along with wattmeter, ammeter, voltmeter & cup full of water. In 2nd Part of rack tube of 36 watt is used. Other instruments like 1st part are also kept. In 3rd Part of set-up, tubes of 40 watt are used along with other instruments. While in tissue culture lab of 40 watt are used. Ammeter, voltmeter, wattmeter were used for measurement of current, voltage & power. Ammeter is used for current measurement. Thermometer is used for measuring temperature of water present in cup. Luxmeter is used to measure light intensity of each tube at a distance of 40 cm as per requirement of tissue culture lab.

All 5 parameters were measured at interval of 1 hr, for 12 hrs, from 7.00 am up to 7.00 pm. This data was collected for 3 days, 6/12/2007, 07/12/2007 & 09/12/2007. (Table 4 & 5).

The result of electrical energy audit analysis shows that energy audit enables in breaking down total energy consumption into various components & helps in identifying areas where maximum saving can be achieved. It aim in accounting for energy generated & its consumption by various categories of consumers & energy required by system elements point thus audit system is vital for progress of any organization.

Due to replacement of the electrical geysers by solar water heater, the electricity consumption is considerably reduced.

After conducting electrical energy audit, provision of the schedule for on-off of tube lights in every room, TV-Hall, kitchen, mess & dhobi-ghat reduces average working hours. Hence saving of Rs. 8629 per year in electricity bill observed. Replacement of existing tubes by efficient tubes. Hence saving of Rs. 19094.4 per year in electricity bill observed.

Due to replacement of the current 47 watt tubes by other tubes of 36 watt, & 28 watt, saving observed:

A. Due to replacement of 47 watt tube by 36 watt saving of Rs.185.6 per day is observed. Total saving per year = 66816 Rs.

B. Due to replacement of 47 watt tube by 28 watt saving of Rs.166.4 per day is observed. Total saving per year = 59904 Rs.

Due to replacement of the current 47 watt tubes by other tubes of 36 watt, & 28 watt,

A. Observed illumination of 1565 lux by 36 watt tube.

B. Observed illumination of 1140 lux by 28 watt tube.

From these studies it can be concluded that use of 36 watt set-up in tissue culture lab & use of 28 watt set-up in ladies hostel with scheduling will be beneficial for minimizing energy consumption.There is possibility to curtile no. of units consumption in hostel: From 1450 to 846 KW-hr. & in tissue culture lab: From 60.16 to 23.04 KW-hr (per day). Accordingly significant saving observed.

Table 1
Room Reading

	7.30 AM	*8.30 AM*	*9.30 AM*	*10.30 AM*	*11.30 AM*	*12.30 PM*	*1.30 PM*	*2.30 PM*	*3.30 PM*	*4.30 PM*	*5.30 PM*	*6.30 PM*	*7.30 PM*	*8.30 PM*
1.3.08 (w/o ill.)	579	630	990	1810	2000	2250	4390	6090	7920	8600	6998	125	0	0
1.3.08 (with ill.)	620	770	1090	1910	2010	2350	5780	7810	8740	9000	7230	3260	120	65
2.3.08 (w/o ill.)	610	628	840	1720	1990	2190	3920	6810	7880	8720	6810	132	0	0
2.3.08 (with ill.)	632	720	996	1897	2066	2290	4910	7520	8640	8930	7020	3100	140	68
3.3.08 (w/o ill.)	575	615	890	1230	1980	2160	4210	6120	7890	8500	5010	138	0	0
3.3.08 (with ill.)	666	720	1120	1830	2030	2260	5610	7900	8600	8690	6990	2010	150	67
4.3.08 (w/o ill.)	577	620	880	1240	1970	2270	4320	6910	7690	8400	5220	135	0	0
4.3.08 (with ill.)	650	690	1130	1720	2060	2355	5520	7890	8500	8590	6820	3006	145	65
5.3.08 (w/o ill.)	570	620	890	1720	1980	2140	4280	5980	8020	8500	5240	137	0	0
5.3.08 (with ill.)	605	750	1150	1840	2050	3060	4520	6002	8400	8620	6010	1110	64	70

Table 2
T. V. HALL

	8:00 AM	*12NOON*	*4:00 PM*	*8:00 PM*
4.3.08 (w/o ill.)	261	458	258	0
4.3.08 (with ill.)	365	552	352	82
5.3.08 (w/o ill.)	258	456	205	0
5.3.08 (with ill.)	321	551	301	83
10.3.08 (w/o ill.)	251	490	180	0
10.3.08 (with ill.)	334	498	243	104
11.3.08 (w/o ill.)	265	398	195	0
11.3.08 (with ill.)	301	432	244	85
15.3.08 (w/o ill.)	263	462	260	0
15.3.08 (with ill.)	367	557	352	87

Table 3
Kitchen

	8:00 AM	*12NOON*	*4:00 PM*	*8:00 PM*
4.3.08 (w/o ill.)	312	264	92	0
4.3.08 (with ill.)	424	355	193	59
5.3.08 (w/o ill.)	323	256	81	0
5.3.08 (with ill.)	413	352	186	62
10.3.08 (w/o ill.)	299	192	87	0
10.3.08 (with ill.)	412	334	194	62
11.3.08 (w/o ill.)	304	195	86	0
11.3.08 (with ill.)	312	240	109	55
15.3.08 (w/o ill.)	312	264	92	0
15.3.08 (with ill.)	424	355	193	59

Table 4
PART-I

Voltage	249	230	220	216	218	228	240	241	242	238	238	254	253
Current	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Wattage	35	35	35	35	35	35	35	35	35	35	35	35	35
Temp.	19.5	21.5	23	23	23.5	24	24	24	24	25	25	25	24
ILLUM-INATION	1187	1121	1082	1062	1086	1067	1223	1170	1181	1135	1172	1159	1175
Time	7.00 AM	8.00 AM	9.00 AM	10.00 AM	11.00 AM	12.00 AM	1.00 PM	2.00 PM	3.00 PM	4.00 PM	5.00 PM	6.00 PM	7.00 PM

Table 5
Electricity unit consumption during project period

Month	*No. of units*	*Amount of Bill (Rs.)*
April-07	1710	9129
May-07	1850	9596
June-07	1290	6538
July-07	990	5051
Augast-07	1410	7262
September-07	1450	7483
October-07	1410	7040
November-07	740	3366
December-07	340	4058
Jan-08	960	4789
Feb-08	780	3743
March-08	850	4184

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